PATENT SPECIFICATION (11) 1 575 719

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(21) Application No. 37368/77 (22) Filed 7 Sep. 1977 (19)
(31) Convention Application No. 51/108539 (32) Filed 10 Sep. 1976 in
(33) Japan (JP)
(44) Complete Specification Published 24 Sep. 1980
(51) INT. CL.^{3} H04N 9/04
(52) Index at Acceptance
H4F CB D1B1 D1D1 D1P3 D1P4 D1Q2 D1Q7 D27C1 D27R1 D27S D30B D30K D30Q D30T2 D53D D81P D83B

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FUMIO NAGUMO
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(54) SOLID STATE TELEVISION CAMERAS

(71) We, SONY CORPORATION, a corporation organised and existing under the laws of Japan, of 7-35 Kitashinagawa-6, Shinagawa-ku, Tokyo, Japan, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:

This invention relates to solid state television cameras.

There have been proposed various solid state colour television cameras which use a semiconductor element such as a bucket brigade device (BBD), charge coupled device (CCD) or the like as a solid state image sensing device. Also, various colour filters which are disposed in front of the solid state image sensing device have been used. One well known colour filter is a so-called double-green type filter, which lets through a greater amount of the green colour component than of the other colour components forming the luminance signal, so as to be more compatible with the eye and to improve the resolution.

This double-green type filter has a plurality of transparent or light transmitting regions the unit area of which corresponds to one picture element. The parts of the filter corresponding to odd horizontal scanning lines contain twice as many green regions G as red or blue regions R and B. For example, the transparent regions of G, R and B are arranged in a horizontal scanning line in the order G-R-G-B repeated sequentially.

For the even horizontal scanning lines, due to the signal process described later, the positions of the transparent regions are so selected that the green colour component G is reversed in phase with respect to the odd horiziontal scanning lines.

Accordingly, when an object is viewed by a camera using the above filter, the spectra and phase relation of the respective colour components become as follows. If the sampling frequency in the horizontal scanning direction is selected as f_C, and the band of the green colour component G is selected at a sampling frequency f_C of 4.5 MHz, the sampling output relating to the green signal includes, in addition to a modulating signal component, (*dc* components or base band components) S_{DG}, a side band component (*ac* component) S_{MG} the carrier of which is the sampling frequency f_C. If the sampling frequency f_C is about 4.5 MHz as set forth above, the relationship of the signal bands becomes such that the side band component S_{MG} is mixed into the modulating signal component S_{DG} to cause a sampling error. This sampling error caused by the side band component S_{MG} deteriorates the reproduced picture. The sampling error is removed by utilising a vertical correlation process. That is, since the phases of the carriers obtained from adjacent horizontal scanning lines are opposite, the sampling error can be removed by vertical correlation.

The carriers of the respective red colour component R and blue colour component B are just one-half that of the green colour component G, so that in the case of the green component G, side band components cannot be removed by the vertical correlation process because the phases of the carriers are not opposite.

Moreover, it is difficult to limit the pass band of only a desired colour signal by an optical device, that is, to form an optical low-pass filter for the purpose of removing the undesirable effects of the side band components.

According to the present invention there is provided a solid state television camera comprising:

a solid state image sensing device including a plurality of individual light sensing units arranged in both horizontal and vertical rows;

means for establishing an image path for projecting an image of an object onto said image sensing device;

a plurality of colour filter elements arranged in horizontal rows in said image path, first alternate horizontal rows each having first alternate elements for passing light of a first primary colour and second alternate elements for passing light representing all colours and second alternate horizontal rows each having first alternate elements for passing light of a second primary colour and second alternate elements for passing light representing all colours;

means for deriving a luminance signal from the outputs from said image sensing device resulting from said colour filter elements;

means for deriving first and second colour difference signals from the outputs from said image sensing device resulting from said colour filter elements corresponding to portions of respective horizontal rows of the image projected thereon; and

means for processing said first and second colour difference signals as a desired simultaneous colour video signal to be mixed with said derived luminance signal.

According to the present invention there is also provided a solid state television camera comprising:

first and second solid state image sensing devices each including a plurality of individual light sensing units arranged in both horizontal and vertical rows;

means for establishing first and second image paths for projecting respective similar images of an object onto said first and second image sensing devices;

said first image path allowing light representing all colours to fall on said first image sensing device;

a plurality of colour filter elements arranged in horizontal rows in said second image path, first alternate rows passing light of a first primary colour and second alternate rows passing light of a second primary colour;

means for deriving a luminance signal from the outputs from said first image sensing device;

means for deriving first and second colour difference signals from the outputs from said first image sensing device and the outputs from said second image sensing device resulting from said colour filter elements corresponding to respective horizontal rows of the image projected thereon; and

means for processing said first and second colour difference signals as a desired simultaneous colour video signal to be mixed with said derived luminance signal.

The invention will now be described by way of example with reference to the accompanying drawings, throughout which like references refer to like elements, and in which:

Figure 1 is a partial front view of an optical colour filter and is used for explaining the invention;

Figures 2A to *2D* are waveform diagrams used for explaining the colour filter shown in Figure 1;

Figure 3 is a partial front view of an optical colour filter used in a prior art television camera and in embodiments of the invention;

Figure 4 is a block diagram showing the circuit of a prior art solid state television camera;

Figure 5 is a front view showing a solid state image sensing device used in embodiments of the invention;

Figure 6 is a block diagram showing the circuit of an embodiment of solid state colour television camera according to the invention;

Figure 7 is a waveform diagram used for explaining the embodiment of Figure 6;

Figures 8, 10, 11 and *12* are block diagrams showing other embodiments of the invention; and

Figure 9 is a front view showing another example of a solid state image sensing device.

In general, when an object is viewed by a television camera using a double-green type colour filter 1 shown in Figure 1, the spectra and phase relation of the colour signal components of the camera are as shown in Figures 2A to 2D.

If it is assumed that the sampling frequency in the horizontal scanning direction is f_C, and the band of a green colour component G is selected as the sampling frequency f_C (about 4.5 MHz), the sampled output signal relating to the green colour signal (for example, the colour signal at the *n*th line) in the output signal from a solid state image sensing device includes, in addition to modulating signal components (*dc* components or base band components) S_{DG}, side band components (*ac* components) S_{MG} the carrier of which is at a

sampling frequency f_C, as shown in Figure 2A. If the sampling frequency f_C is about 4.5 MHz as set forth above, the relation of the signal bands is as shown in Figure 2A where side band components S_{MG} are mixed into the modulating signal components S_{DG}. Thus a sampling error is caused which will deteriorate the reproduced picture. In general, the sampling error is removed by utilizing the vertical correlation theory or process. That is, the phase of the carrier obtained from an adjacent horizontal scanning line (for example, the $(n+1)$th line) is opposite to that from the nth horizontal scanning line as may be apparent from Figure 1, so that the output spectra shown in Figure 2B is obtained from the $(n+1)$th scanning line. Thus, a so-called vertical correlation process to mix adjacent lines is carried out, and the sampling error is accordingly removed.

Since the respective carriers of the red component R and the blue component B are just one-half of the green component G, the relationship between the modulating signal components S_{DR}, S_{DB} and the side band components S_{MR}, S_{MB}, to the respective red and blue components R and B is as shown in Figure 2C. That is, the carrier of the red component R in a predetermined horizontal line is in opposed phase relation to the carrier of the blue component B, and the carriers of the red and blue components in the succeeding line are also in opposed phase relation. In this case, although the red and blue components R and B are obtained from each horizontal scanning line, the successive same colour signal information in the horizontal or line period are not in opposed phase relation (advanced by 90°) and hence it is impossible to remove the side band components S_{MR} (S_{MB}) by the vertical correlation process used in the case of green component G. In Figure 2C, the colour components at the $(n+1)$th line are designated by reference letters in parenthesis.

If the level of the *dc* components mixed in the low band side of the side band components is sufficiently low as compared with that of the modulating signal components, no serious problem may occur. However, if the carriers of components R and B are low, such as $\frac{1}{2}f_C$, as in the above example, the level ratio of the side band components mixed in the low band of the *dc* components is large, and accordingly the effect of the side band components on the reproduced picture cannot be neglected.

In order to remove the above effect on the reproduced picture, if the bands of the R and B components are lower than $\frac{1}{4}f_C$ due to optical means, the relation between the modulating and side band components becomes as shown in Figure 2D where the side band component does not mix with the modulating component. However, it is not easy to limit the pass band to an optically desired wavelength or to provide an optical low-pass filter of the wavelength dependent type.

In order to remove or eliminate the above sampling error without using an above optical low-pass filter, it may be considered that the light separation characteristic of the colour filter 1, Figure 3, is selected such that a light component Y, which is called the luminance signal in the standard system, is obtained from a desired transparent region. That is, in this colour filter 1, the odd line is selected or formed of the transparent regions Y-R-Y-R... and the even line is formed of the transparent regions B-Y-B-Y... . If the transparent regions Y are selected to be opposed in phase at every line, the luminance component Y becomes opposite in phase at every line. Thus, a sampling error due to the luminance component Y can be removed by the vertical correlation process as in the process of the green signal components in Figure 1.

Since the carrier of components R and B have the same frequency as that of component Y, and their pass bands are not restricted, the relation between the modulating components and side band components in R and B become the same as that shown in Figure 2A. As for the side band components relating to components R and B, vertical correlation cannot be utilized so that the side band components remain within the respective modulating components. However, the level of the side band components existing in the low band side of the modulating component under the remaining state shown in Figure 2A is much lower than that of the prior art shown in Figure 2c, and hence the effect of the remaining side band component on the reproduced picture presents no problem in practical use.

Figure 4 shows the circuit of a television camera in which the colour filter of Figure 3 is used and a CCD chip of the frame transfer system type shown in, for example, Figure 5 is used as a solid state image sensing device 10. This solid state image sensing device or CCD 10 comprises an image sensing array 10A, which includes a plurality of image sensing cells, picture elements or light sensing units 2, arranged in rows and columns on which an image of an object O is projected through an optical lens system L and a colour filter 1. A temporary storage array 10B, which stores the charge carriers induced in response to the image of the object O, and a horizontal shift register 10C for reading out the stored carriers with an output terminal 3 is also shown.

The solid state image sensing device or CCD 10 is supplied with a driving pulse signal Pa from a synchronizing signal generator 11. This driving pulse Pa includes a plurality of pulses which are necessary to induce carriers in response to the image of the object O, transfer the

carriers and read out the carriers, respectively. The luminance signal Y in the picked up output signal obtained at the terminal 3 is subjected to the vertical correlation process. To this end, the output signal from the terminal 3 is fed to a sampling hold circuit 12 and a luminance signal Y_i read out from sampling hold circuit 12 is supplied to a vertical correlation process circuit 20. In the circuit of Figure 4, in order to avoid deterioration of the resolution in the vertical direction, the low band component of the luminance signal Y_i is not subject to the vertical correlation process except at its high band end. Accordingly, in the vertical correlation process circuit 20, the luminance signal Y_i is fed at first to a low-pass filter 13 through which a low band component Y_L about (500 to 1000 KHz) of the luminance signal Y_i is derived. Since the low band component Y_L and the luminance signal Y_i are fed to a subtractor 14, this subtractor 14 produces only a high band component Y_H of the luminance signal Y_i. The high band component Y_H is fed through a 1H delay line or circuit 15 (H is the horizontal line period) to an adder 16 which is also supplied with the component Y_H which is not delayed.

Since the phase relation between the carriers of adjacent horizontal scanning lines is opposite, the side band components are cancelled by the above signal process. As a result, if the output signal from the adder 16 and the low band component Y_L are supplied to the next stage of an adder 17, this adder 17 produces a luminance signal Y_O, from which the side band components are removed. A delay line or circuit 18 is provided at the input side of the subtractor 14 which serves to correct the inconsistency of the transmission time caused by the time delay of the low-pass filter 13.

Since the red component R and blue component B are obtained at every 2H, in order to obtain a desired colour video signal S_o, it is necessary that these components R and B be obtained simultaneously and successively as the luminance signal Y. The circuit for this purpose will be described.

The output signal from the terminal 3 is applied to a sampling hold circuit 21 which produces a red colour signal R (or blue colour signal B) and supplies it through a low-pass filter 22 to a simultaneous circuit 23 which is formed of a 1H delay line or circuit 24 and a switching circuit 25. The switching circuit 25 is formed so as always to supply a red colour signal R to one output terminal and a blue colour signal B to the other output terminal. That is, if the switching circuit 25 is shown mechanically, it would be formed as a double-throw, double-contact switch as shown in Figure 4. In this case, a delayed output signal from the delay circuit 24 and a non-delayed output signal from the low-pass filter 22 are supplied to the switching circuit 25 at the desired terminals, respectively. A pair of switches, SW_a and SW_b of switching circuit 25 are changed over by a control signal P_b from the signal generator 11 at every 1H.

Thus, the primary colour signals R and B (sampled output signals) which are obtained alternately at every 1H are applied simultaneously and then supplied to the output side of the switching circuit 25. The simultaneous primary colour signals R and B together with the luminance signal Y_O are fed to an encoder 26 which produces at an output terminal 27 colour television signal S_o of a standard system, such as the NTSC system. In this case, the encoder 26 and the sampling hold circuits 12 and 21 are supplied with desired driving pulses Pc and Pd from the generator 11.

In the case where the primary colour signals R and B are provided simultaneously and the desired colour video signal S_o is produced as described above, the defects caused by the sampling error can be removed, but the following new problem occurs. Since the primary signals are made simultaneous and the sampling output signals at adjacent horizontal lines are used simultaneously, if the output signals at the nth line (for example, odd line) and the $(N+1)$th line are taken into consideration, colour difference output signals $E_{CR(N)}$ and $E_{CR(N+1)}$ at the respective lines can be expressed by the following equations, respectively.

$$E_{CR(N)} = \{ R_{(N)} - Y_{O(N)} \} + b \{ B_{(N-1)} - Y_{O(N)} \} \quad \ldots(1)$$

$$E_{CR(N+1)} = a \{ R_{(N)} - Y_{O(N+1)} + b \{ B_{(N+1)} - Y_{O(N+1)} \quad \ldots(2)$$

where a and b are constants.

Accordingly, with the colour difference signal, each line contains the primary colour signal, so that when an image having no vertical correlation is picked up, especially a black-and-white image, the colour difference signals expressed do not become "zero". As a result, the picture is reproduced with colour, and hence the picture reproduction is deteriorated. In other words, the colour difference signal $E_{CR(N)}$ at the Nth line contains also the primary colour signal $B_{(N-1)}$ and the colour difference signal $E_{CR(N+1)}$ at the $(N+1)$th line contains the primary colour signal $R_{(N)}$. Thus, when the contents of a picture are different at every line, the primary colour signals $B_{(N-1)}$ and $R_{(N)}$ are not always at the correct level.

An embodiment of solid state colour television camera according to the invention which removes deterioration of the reproduced picture caused by the side band components (without using an optical low-pass filter) and also eliminates any effect caused by the absence of vertical correlation, will be hereinafter described with reference to Figure 6 and 7 where elements which are the same as those of Figure 4 are marked with the same reference numerals and letters.

In this embodiment, the primary colour signals are not processed simultaneously, but the colour difference signals are processed simultaneously. In this case, it is possible for colour difference signals R-Y and B-Y to be extracted from the side band components or modulating components, respectively.

The embodiment shown in Figure 6 is the case where the colour difference signals are extracted from the side band components. In this case, since the colour filter 1 shown in Figure 3 is employed, the relationship between the modulating component and side band component is as shown in figure 7. As to the side band component, at an odd line, the luminance signal Yi and primary colour signal R are obtained in opposite phase, and similarly at an even line, the luminance signal Yi and the primary colour signal B are obtained in opposite phase. Thus, the desired colour difference signals R-Y and B-Y can be obtained from the side band components at respective lines in a line sequential manner.

Therefore, as shown in Figure 6, the respective sampled output signals of the components Y and R (or B) obtained from the sampling hold circuit 21 are fed to a band pass filter 30 from which a side band component having a desired band (500 KHz to 1 MHz) with the carrier frequency f_C as its centre (shown in Figure 7 by the dotted line) is derived. In this case, the synchronization of the pulse fed from signal generator 11 to the sampling hold circuit 21 is different from that of Figure 4 and the driving pulse Pd' which can samplehold all the signals from every picture element, is fed to the sampling hold circuit 21 from the generator 11.

If the side band components from the band pass filter 30 are applied to the delay circuit 24 to be made simultaneous, the colour difference signals R-Y and B-Y can be obtained from the switching circuit 25 simultaneously. These signals R-Y and B-Y are supplied to demodulators 31 and 32 to be demodulated. The demodulated output signals from the demodulators 31 and 32 are fed through low-pass filters 33 and 34 to an encoder 26. Although the side band components extracted by the band pass filter 30 contain the high band component of the modulating component as shown in Figure 7, the level of this high band component is very low, so that the high band component can be neglected.

If the colour difference output signals $E_{CR(N)}$ and $E_{CR(N+1)}$ obtained in the embodiment are expressed similarly to equations (1) and (2), the following equations (3) and (4) are obtained respectively.

$$E_{CR(N)} = \{ R_{(N)} - Y_{O(N)} \} + b \{ B_{(N-1)} - Y_{O(N-1)} \} \qquad \ldots(3)$$

$$E_{CR(N+1)} = a \{ R_{(N)} - Y_{O(N)} \} + b \{ B_{N+1)} - Y_{O(N+1)} \} \qquad \ldots(4)$$

The colour difference signals expressed by equations (3) and (4) also contain the primary colour signals, but the above primary colour signals contain the luminance signals. Thus, even in the case that there is no vertical correlation, especially where a black-and-white image is picked up, the terms with constants *a* and *b* in equations (3) and (4) become "zero", respectively. As a result, the reproduced picture does not include colour.

As described above, the colour difference signals R-Y and B-Y obtained from the image sensing device 10 are made simulatneous, and these simultaneous colour difference and luminance signals are used to provide the desired colour video signal so that there is achieved the advantage that deterioration of the reproduced picture can be avoided regardless of the use of vertical correlation and without using an optical low-pass filter.

With the embodiment shown in Figure 6, the respective colour difference signals R-Y and B-Y are produced from the side band components, but it is possible that the same colour difference signals can be produced from the *da* component or base component.

Figure 8 is a block diagram showing another embodiment of the invention. In this embodiment the luminance signal Y_i and the primary colour signal R or B obtained independently from the sampling hold circuits 12 and 21 are fed to a subtractor circuit 36 to be subjected to a subtraction process. Thus, the subtractor circuit 36 produces colour difference signal R-Y_i or B-Y_i. If this signal is fed through a low-pass filter 37 to a simultaneous circuit 23, the colour difference signals R-Y and B-Y can be simultaneously obtained therefrom.

In the embodiment shown in Figures 6 and 8, there are provided two delay circuits 15 and 24, each of which has a 1H delay period, (although they are not shown in Figure 8), but a single delay circuit will do. In this case, another delay circuit can be provided associated

with the solid state image sensing device 10. That is, as shown in Figure 9, a delay element 40, whose bit number is selected to be the same as that of the horizontal shift register 10C of the solid state image sensing device 10, is formed on a semiconductor substrate on which the horizontal shift register 10C is formed. An output signal supplied to an output terminal 3A of the horizontal shift register 10C is supplied to the delay element 40, and the signal is read-out by a clock pulse fed to the horizontal shift register 10C. Thus, an output signal which is delayed by 1H is obtained at an output terminal 3B.

Figure 10 is a block diagram showing a further embodiment of the invention in which the solid state image sensing device 10 is shown in Figure 9 is employed. In this embodiment, a delay line or circuit 18 with the delay time of 1H is provided in the luminance signal transmission system, but the delay element 40 is used in the colour difference signal transmission system. For this reason, the output signals at terminals 3A and 3B are fed through sampling hold circuits 21A and 21B to band pass filters 30A and 30B from which line sequential colour difference output signals are obtained, respectively, similar to the case of Figure 6. When the colour difference signal R-Y is obtained at the terminal 3A, the colour difference signal B-Y is obtained at the terminal 3B. Thus, if these colour difference signals are supplied to simultaneous circuit 23 which is formed of only a switching circuit 25, the colour difference signals can be made simultaneous. Other portions of the circuit construction of Figure 10 are substantially the same as those of Figure 6.

In the luminance signal transmission system shown in Figure 10, a circuit construction is employed in which two luminance signals obtained at the terminals 3A and 3B are subjected to a correlation process. A newly provided adder 42 is supplied with two luminance signals from sampling hold circuits 12A and 12B to cancel side band components thereof as described previously. In this case, however, if the output signal itself from the adder 42 is taken as a luminance signal Y_O, the resolution in the vertical direction is deteriorated. Therefore, in this embodiment the high band component of the output signal from the adder 42 is used as the high band component of the luminance signal Y_O. The low band component of any one of the output signals from the terminals 3A and 3B is used as the low band component of the luminance signal Y_O. In the embodiment of Figure 10, the output signal at the terminal 3A is used. In Figure 10, 41 designates a low-pass filter for obtaining the above low band component Y_L, which is supplied with the output signal from the sampling hold circuit 12B and which supplies its output signal Y_L to an adder 16. A delay line 43 is used for fine adjustment if necessary. The description of the other circuit elements will be omitted since they are substantially the same as those of Figure 6.

Figure 11 is a block diagram showing another embodiment of the invention in which an ordinary solid state image sensing device as shown in Figure 5 is used in a way to decrease the number of delay circuits. In the embodiment of Figure 11, a trap circuit 45 is supplied with the output signal from the sampling hold circuit 12 to produce the luminance signal which has a carrier frequency f_C which is trapped. This luminance signal from the trap circuit 45 and the side band component of the primary colour signal from the band pass filter 30, are supplied to an adder 46 to be added together. The output signal from the adder 46 is fed through a 1H delay circuit 47 to an adder 48 which is also supplied with the output signal from the adder 46 directly, so that the side band components are cancelled in the adder 48. Since the output signal from the adder 48 contains the side band components relating to the colour signal R or B, a trap circuit 49 is provided following the adder 48 so as to remove the above said band components.

As for the colour signal transmission system, if a circuit using the output signal itself from the adder 46 and that from the delay circuit 47 is formed similarly to the circuit shown in Figure 10, the colour difference signal can be made simultaneous.

In Figures 5 and 9, a CCD of a so-called frame transfer system type is shown; it is of course possible that a CCD of the well-known interline system type can be used.

Further, in the above description the case where only one CCD is used is explained, but the invention can be applied to a case where two or more CCDs are employed.

Figure 12 is a schematic block diagram showing a further embodiment of the invention in which two solid state image sensing devices or CCD's 10A and 10B are used. In the embodiment shown in Figure 12, an image of an object O is projected through a lens system L, a half mirror H_A, and a suitable filter 1A to the CCD 10A from which only the luminance signal is derived. Also, the image of the object O is projected through the lens system L, the half mirror H_A, a mirror H_B and a colour filter 1B (consisting of strip color filter elements R and B, each of which is elongated in the horizontal direction and arranged alternately in the vertical direction) to the other CCD 10B from which the primary colour signals R and B are obtained in line sequence. The output signals obtained at the output terminals 3A and 3B are processed by a circuit similar to that shown in Figure 8 to produce the colour difference signals.

WHAT WE CLAIM IS:-

1. A solid state television camera comprising:
a solid state image sensing device including a plurality of individual light sensing units arranged in both horizontal and vertical rows;
means for establishing an image path for projecting an image of an object onto said image sensing device;
a plurality of colour filter elements arranged in horizontal rows in said image path, first alternate horizontal rows each having first alternate elements for passing light of a first primary colour and second alternate elements for passing light representing all colours and second alternate horizontal rows each having first alternate elements for passing light of a second primary colour and second alternate elements for passing light representing all colours;
means for deriving a luminance signal from the outputs from said image sensing device resulting from said colour filter elements;
means for deriving first and second colour difference signals from the outputs from said image sensing device resulting from said colour filter elements corresponding to portions of respective horizontal rows of the image projected thereon; and
means for processing said first and second colour difference signals as a desired simultaneous colour video signal to be mixed with said derived luminance signal.

2. A camera according to claim 1, wherein said colour filter elements are arranged to pass therethrough light representing all colours in opposing phase relationship as between successive horizontal rows and to pass therethrough said first and second primary colour information in opposing phase relationship as between successive horizontal rows.

3. A camera according to claim 1 wherein said first and second primary colours comprise red and blue.

4. A camera according to claim 1 wherein the carriers representing said primary colour and luminance signals have the same frequency and opposing phases as said image light is projected along a predetermined horizontal row of said image sensing device.

5. A camera according to claim 1 further comprising a luminance signal processing circuit for avoiding a sampling error of said luminance signal derived from said image sensing device by using vertical correlation in which the derived luminance signals from successive horizontal scanning lines are mixed together.

6. A camera according to claim 5 wherein high frequency components of said developed luminance signals obtained from successive horizontal scanning lines are mixed together.

7. A solid state television camera comprising:
first and second solid state image sensing devices each including a plurality of individual light sensing units arranged in both horizontal and vertical rows;
means for establishing first and second image paths for projecting respective similar images of an object onto said first and second image sensing devices;
said first image path allowing light representing all colours to fall on said first image sensing device;
a plurality of colour filter elements arranged in horizontal rows in said second image path, first alternate rows passing light of a first primary colour and second alternate rows passing light of a second primary colour;
means for deriving a luminance signal from the outputs from said first image sensing device;
means for deriving first and second colour difference signals from the outputs from said first image sensing device and the outputs from said second image sensing device resulting from said colour filter elements corresponding to respective horizontal rows of the image projected thereon; and
means for processing said first and second colour difference signals as a desired simultaneous colour video signal to be mixed with said derived luminance signal.

8. A solid state television camera substantially as hereinbefore described with reference to Figure 6 of the accompanying drawings.

9. A solid state television camera substantially as hereinbefore described with reference to Figure 8 of the accompanying drawings.

10. A solid state television camera substantially as hereinbefore described with reference to Figures 9 and 10 of the accompanying drawings.

11. A solid state television camera substantially as hereinbefore described with reference to Figure 11 of the accompanying drawings.

12. A solid state television camera substantially as hereinbefore described with reference to Figure 12 of the accompanying drawings.

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Printed for Her Majesty's Stationery Office, by Croydon Printing Company Limited, Croydon, Surrey, 1980.
Published by The Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.

1575719 COMPLETE SPECIFICATION

8 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 1

Fig. 1

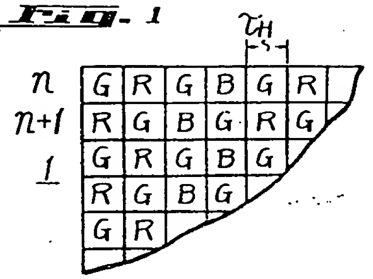

Fig. 2A

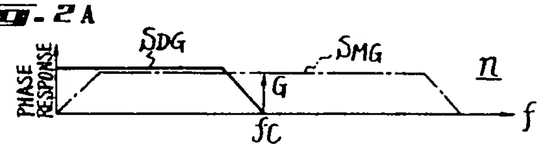

Fig. 2B

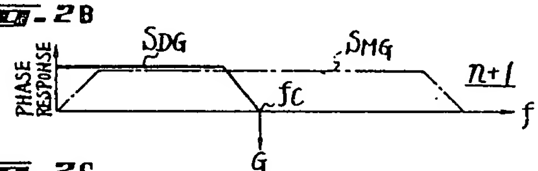

Fig. 2C

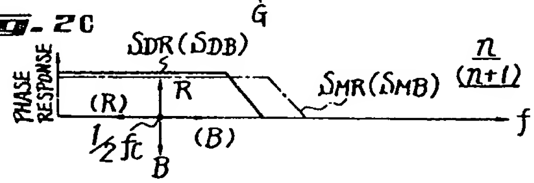

Fig. 2D

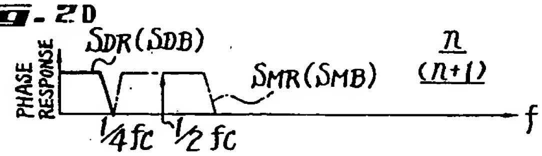

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Fig. 5

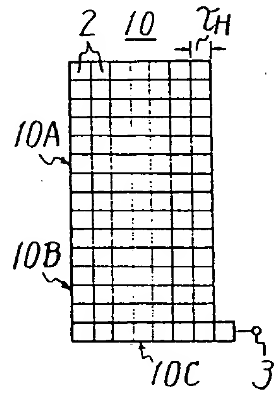


Fig. 3

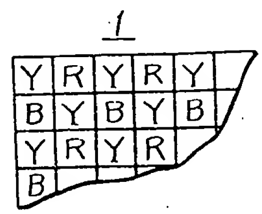
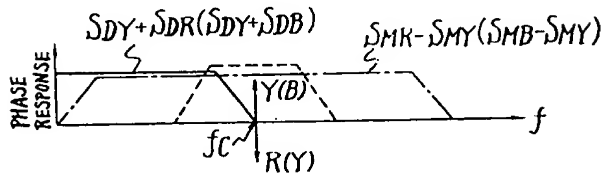


Fig. 7



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1575719 COMPLETE SPECIFICATION

8 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 3

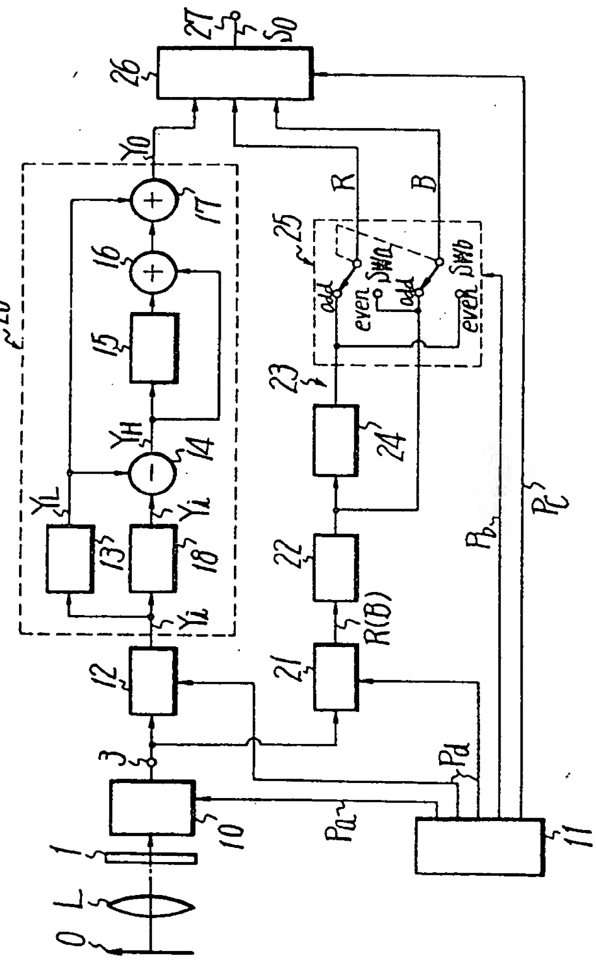

Fig. 4

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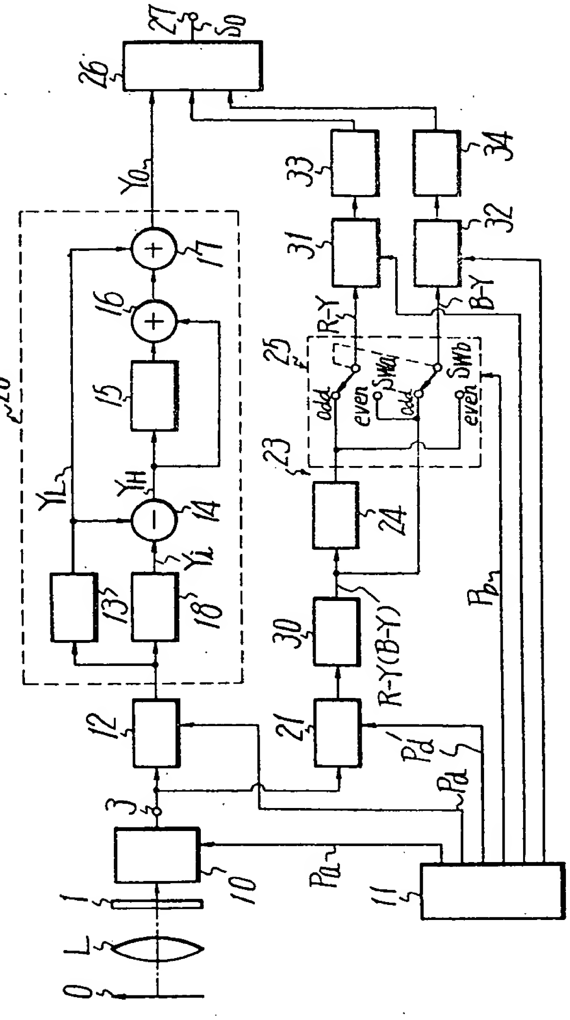
O
L
1
10
3
12
11
Pa
Pd
Pd'
21
R-Y(B-Y)
30
24
23
25
odd
even
SWa
SWb
R-Y
B-Y
Pb
31
32
33
34
26
27
So
Yo
13
18
14
15
16
17
20
YL
YH

Fig. 6

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Fig. 8

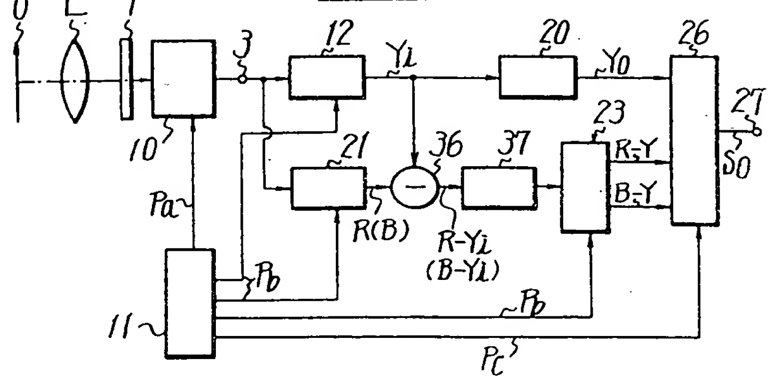
0
L
1
10
3
12
Yl
20
Yo
26
27
So
21
36
37
23
R-Y
B-Y
Pa
R(B)
R-Yl
(B-Yl)
Pb
11
Pb
Pc

Fig. 9

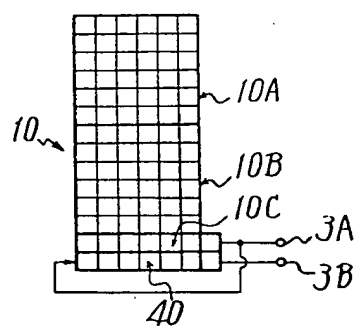
10A
10
10B
10C
3A
3B
40

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Fig. 10

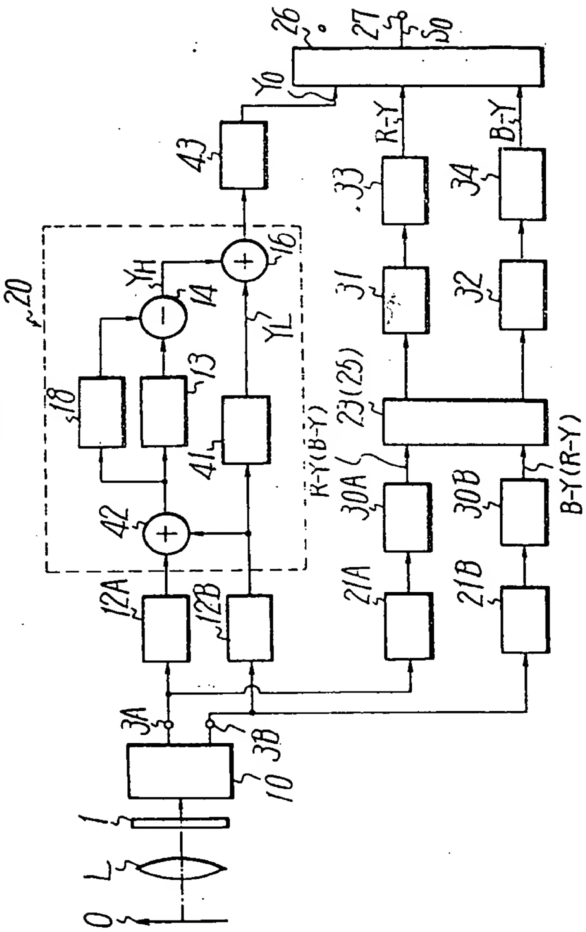
O
L
1
10
3A
3B
12A
12B
42
41
18
13
14
16
20
YH
YL
R-Y(B-Y)
43
Y0
26
27
50
21A
21B
30A
30B
23(25)
B-Y(R-Y)
31
32
33
34
R-Y
B-Y

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Fig. 11

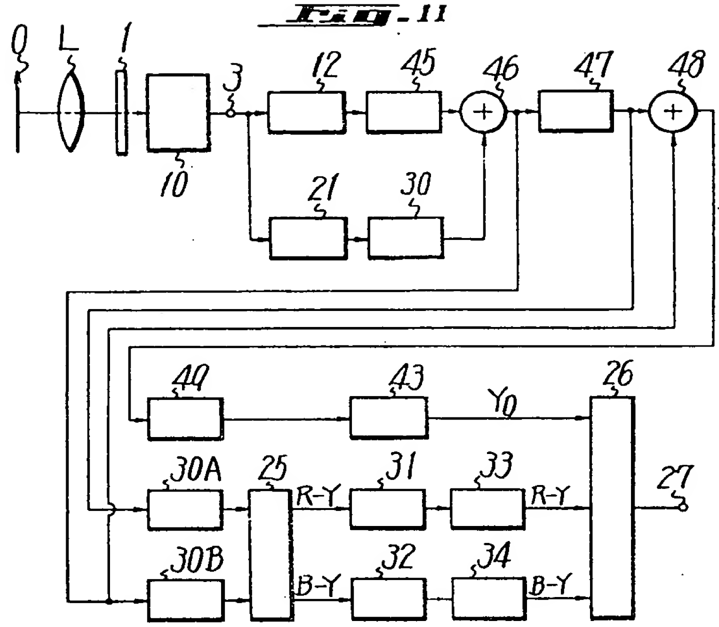
O
L
1
3
10
12
45
46
47
48
21
30
40
43
Y0
26
30A
25
R-Y
31
33
R-Y
27
30B
B-Y
32
34
B-Y

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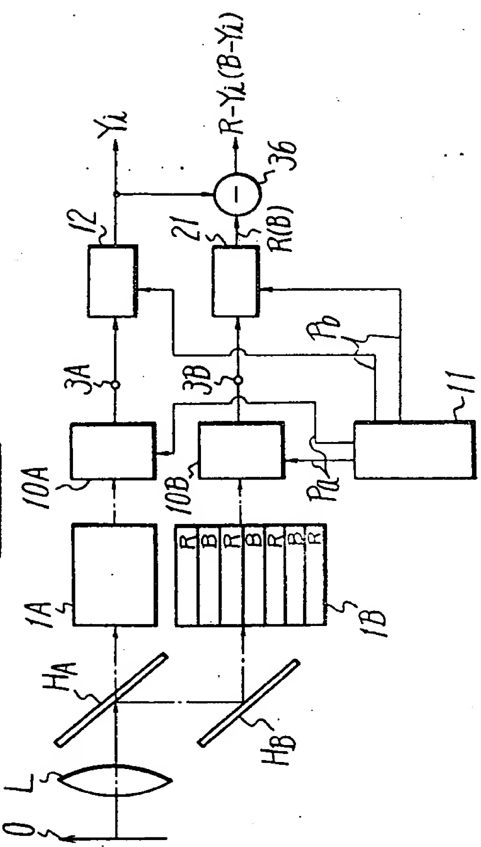
Fig. 12



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